CLAIMS

1. A method of analyzing leakage current luminescence in CMOS circuits, comprising the steps of:

collecting light emission data from each of a plurality of CMOS circuits;

separating the CMOS circuits into first and second groups;

for the first group of CMOS circuits, analyzing the emission data from the CMOS circuits, based on the presence or absence of leakage light from the CMOS circuits, to identify logic states for the CMOS circuits; and

for the second group of CMOS circuits, analyzing the emission data from the CMOS circuits, based on modulation of the intensity of the light from the CMOS circuits, to determine values for given parameters of the circuits.

2. A method according to Claim 1, wherein:

each of the CMOS circuits includes a multitude of individual switching devices; and

the step of analyzing the emission data from the first group of CMOS circuits includes the step of analyzing emission data from one of the CMOS circuits of said first group to determine the logic states of each of at least some of the switching devices of said one of the CMOS circuits.

3. A method according to Claim 2, wherein the step of analyzing the emission data from the first group of CMOS circuits includes the further step of reconstructing the logical state of said one of the CMOS circuits from the determined logic states of said at least some of the switching device.

4. A method according to Claim 1, wherein the step of analyzing the emission data from the first group of CMOS circuits includes the step of analyzing the emission data from one of the CMOS circuits of said first group when said one of the CMOS circuits is operating at a defined speed.

5. A method according to Claim 1, wherein the step of analyzing the emission data from the first group of CMOS circuits includes the step of analyzing the emission data from one of the CMOS circuits of said first group when said one of the CMOS circuits is stopped.

6. A method according to Claim 1, wherein the step of analyzing the emission data from the second group of CMOS circuits includes the steps of, for at least one of the CMOS circuits of said second group,

determining a relationship between the given parameter and the intensity of light from the one of the CMOS circuits;

measuring the intensity of light emitted from the one of the CMOS circuits; and

comparing said measured intensity with said determined relationship to determine the value for the given parameter on said one of the CMOS circuits.

7. A method according to Claim 1, wherein the given parameter is selected from the group comprising temperature, crosstalk noise, and power supply noise.

8. A method according to Claim 1, wherein:

each of the CMOS circuits includes a multitude of individual switching devices; and

the step of analyzing the emission data from the second group of CMOS circuits includes the step of analyzing the emission data from one of the CMOS circuits of the second group to determine a temperature of one of the individual switching devices of said one of the CMOS circuits.

9. A method according to Claim 1, wherein:

each of the CMOS circuits includes a multitude of individual switching devices; and

the step of analyzing the emission data from the second group of CMOS circuits includes the step of analyzing emission data from one of the CMOS circuits of the second group to determine a temperature distribution among the switching devices of said one of the CMOS circuits.

10. A system for analyzing leakage current luminescence CMOS circuits, comprising:

means for collecting light emission data from each of a plurality of CMOS circuits;

means for analyzing the emission data from a first group of CMOS circuits, based on the presence or absence of leakage light from the CMOS circuits, to identify logic states for the CMOS circuits of said first group; and

means for analyzing the emission data from a second group of CMOS circuits based on modulation of the intensity of the light from the CMOS circuits, to determine values for given parameters of the CMOS circuits of said second group.

11. A system according to Claim 10, wherein:

each of the CMOS circuits includes a multitude of individual switching devices; and

the means for analyzing the emission data from the first group of CMOS circuits includes means for analyzing emission data from one of the CMOS circuits of said first group to determine the logic states of each of at least some of the switching devices of said one of the CMOS circuits

12. A system according to Claim 11, wherein the means for analyzing the emission data from the first group of CMOS circuits further includes means for reconstructing the logical state of said one of the CMOS circuits from the determined logic states of said at least some of the switching device.

13. A system according to Claim 10, wherein the means for analyzing the emission data from the first group of CMOS circuits includes means for analyzing the emission data from one of the CMOS circuits of said first group when said one of the CMOS circuits is operating at a defined speed.

14. A system according to Claim 10, wherein the means for analyzing the emission data from the first group of CMOS circuits includes means for analyzing the emission data from one of the CMOS circuits of said first group when said one of the CMOS circuits is stopped.

15. A system according to Claim 10, wherein the means for analyzing the emission data from the second group of CMOS circuits includes:

means for determining a relationship between the given parameter and the intensity of light from at least one of the CMOS circuits of the second group;

means for measuring the intensity of light emitted from the one of the CMOS circuits; and

means for comparing said measured intensity with said determined relationship to determine the value for the given parameter on said one of the CMOS circuits.

16. A system according to Claim 10, wherein the given parameter is selected from the group comprising temperature, crosstalk noise, and power supply noise.

17. A system according to Claim 10, wherein:

each of the CMOS circuits includes a multitude of individual switching devices; and

the means for analyzing the emission data from the second group of CMOS circuits includes means for analyzing the emission data from one of the CMOS circuits of the second group to determine a temperature of one of the individual switching devices of said one of the CMOS circuits.

18. A system according to Claim 10, wherein:

each of the CMOS circuits includes a multitude of individual switching devices; and

the means for analyzing the emission data from the second group of CMOS circuits includes means for analyzing emission data from one of the CMOS circuits of the second group to determine a temperature distribution among the switching devices of said one of the CMOS circuits.

19. A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform method steps for analyzing leakage current luminescence in CMOS circuits, said circuits being separated into first and second

groups based on light emission data collected from the CMOS circuits, said method steps comprising:

analyzing the emission data from the first group of CMOS circuits based on the presence or absence of leakage light from the CMOS circuits to identify logic states for the CMOS circuits; and

analyzing the emission data from the second group of CMOS circuits based on modulation of the intensity of the light from the CMOS circuits to determine values for given parameters of the circuits.

20. A program storage device according to Claim 19, wherein:

each of the CMOS circuits includes a multitude of individual switching devices; and

the step of analyzing the emission data from the first group of CMOS circuits includes the step of analyzing emission data from one of the CMOS circuits of said first group to determine the logic states of each of at least some of the switching devices of said one of the CMOS circuits.

21. A program storage device according to Claim 19, wherein the step of analyzing the emission data from the second group of CMOS circuits includes the steps of, for at least one of the CMOS circuits of said second group,

determining a relationship between the given parameter and the intensity of light from the one of the CMOS circuits;

measuring the intensity of light emitted from the one of the CMOS circuits; and

comparing said measured intensity with said determined relationship to determine the value for the given parameter on said one of the CMOS circuits.

22. A method of measuring the temperature of a CMOS circuit, comprising the steps of:

determining a relationship between the intensity of leakage light from the CMOS circuit and the temperature of the circuit;

using photon emission microscopy to measure photons emitted from the CMOS circuit during a defined time period;

analyzing the photon measurements made by the photon emission microscopy to determine the intensity of light emitted from the CMOS circuit during the defined time period; and

comparing said determined intensity with said determined relationship to determine the temperature of the CMOS circuit.

23. A method according to Claim 22, wherein the CMOS circuit includes a multitude of individual switching devices, and the comparing step includes the step of determining the temperature distribution among said devices.

24. A method of measuring cross-talk noise in a CMOS circuit, comprising the steps of:

determining a relationship between leakage light from the circuit with a given voltage in the circuit;

using photon emission microscopy to measure photons emitted from a given area of the CMOS circuit during a defined time period;

analyzing the photon emission measurements made using the photon emission microscopy; and

comparing the analyzed photon emission measurements with the determined relationship to provide quantitative information about cross talk noise in said given area.

25. A method according to Claim 24, wherein the step of determining a relationship between leakage light from the circuit and a given voltage in the circuit includes the steps of:

obtaining a first photon emission image for a pattern representing a low level of cross talk;

obtaining a second photon emission image for a pattern representing a high level of cross talk; and

computing the difference between the first and second photon emission images.

26. A method of characterizing noise from a power supply on a CMOS circuit, comprising the steps of:

providing a set of calibration curves that relate leakage light from the circuit to a given voltage in the circuit;

using photon emission microscopy to measure photons emitted from a given area of the circuit during a defined time period; and

comparing photon measurements made by the photon emission microscopy with the calibration curves to identify transient variations in said power supply.

27. A method according to Claim 26, wherein:

the power supply applies a drain-to-source voltage to transistors of the circuit; and

the step of providing a set of calibration curves includes the step of providing a set of calibration curves that relate leakage light from an individual transistor of the circuit to the drain-to-source voltage applied to said individual transistor.